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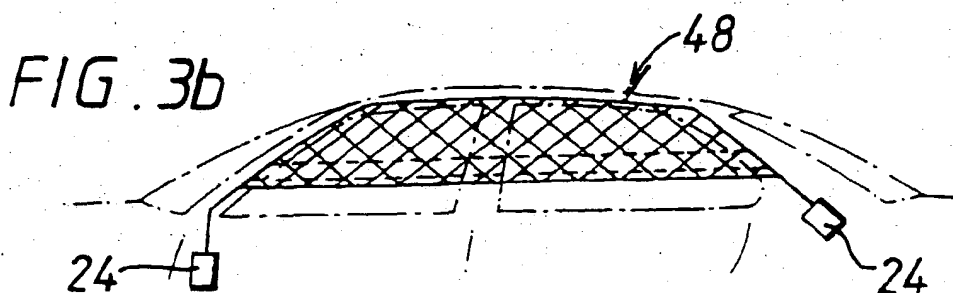
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(54) **An inflatable restraint for a vehicle occupant**

(57) A restraint (10) comprises an inflatable curtain (14) and a deployment member (16,38). The deployment member can be an inflatable tube within a braided tube (16) or an elastic member (38). The deployment member is attached to the inflatable curtain (14) and on

receipt of a signal the member (16,38) deploys the curtain into an occupant protection position in the event of a crash. The restraint is particularly intended for location on one side of a vehicle to provide protection against side impacts.



According to a fourth aspect of the invention there is provided a restraint for a vehicle occupant, the restraint comprising an inflatable bag having a non-extensible flexible member connected thereto whereby expansion of the bag is limited by the flexible member becoming taut on inflation of the bag.

In that way the bag is prevented from extending too far into the vehicle or from over inflating.

The bag may comprise a curtain. In such a case, the non-extensible flexible member may be connected along an outer edge of the curtain. The curtain may deploy downwardly and, in such a case, the flexible member may be located along the lowermost edge thereof. The flexible member may run along a guide and, in a preferred embodiment, runs along respective guides. The guides are preferably inclined relative to each other, most preferably at 90°. Non-return means may prevent return of one end or both ends of the flexible member following inflation of the bag.

A plurality of deployment members may be provided. The deployment members may be linked by structural members. The structural members preferably provide structural rigidity to the curtain upon deployment and inflation thereof.

Inflatable restraints in accordance with aspects of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings in which:

Fig 1a is an elevation of a restraint in accordance with the first aspect of the invention, in the undeployed state,

Fig 1b is a view similar to Fig 1a with the restraint in the deployed state,

Fig 2a is an elevation of a further restraint in accordance with the first aspect of the invention in the undeployed state,

Fig 2b is a similar view to Fig 2a with the restraint in the deployed state,

Figs 3a and 3b are elevations of a restraint in a vehicle, the restraint extending from the front door pillar to the rear door pillar, in undeployed and deployed states respectively,

Figs 4a and 4b are elevations of separate driver and passenger restraints in a vehicle in accordance with the first aspect of the invention, shown in undeployed and deployed states respectively,

Figs 5a and 5b are elevations of another inflatable restraint in a vehicle in accordance with the first aspect of the invention in undeployed and deployed states respectively,

Figs 6a and 6b are elevations of two restraints of the kind shown in Figs 5a and 5b for a driver and passenger the restraints being shown in undeployed and deployed states respectively,

Fig 7 is an elevation of the curtain part of the restraint shown in Figs 3a and 3b in an unfolded state,

Fig 8 is an elevation of the curtain part of the restraint of Figs 3 and 7,

Fig 9 is an exploded perspective view of the inflating device for use inflating the curtain of Figs 3, 7 and 8,

Fig 10 is an elevation of the curtain part of the restraint of Figs 3, 7 and 8 showing the tubular structure inside the curtain,

Figs 11a and 11b are perspective views of alternative embodiments of head air bag which can be connected to the curtain in fluid communication therewith,

Fig 12 is a schematic sectional view showing the location of an undeployed restraint in a vehicle,

Figs 13a and 13b are schematic elevations of a curtain having multiple deployment members in undeployed and deployed states respectively,

Figs 14a and 14b are schematic elevations of curtains in accordance with the first aspect of the invention having multiple deployment members and structural members for strengthening,

Fig 15a and 15b are schematic elevations of an inflatable restraint for a vehicle in accordance with the fourth aspect of the invention,

Fig 16 is an elevation of part of a curtain in accordance with the third aspect of the invention,

Fig 17 is an elevation of the curtain of Fig 16 looking in the direction of arrow XVII in Fig 16, and

Fig 18 is a schematic elevation of a plurality of curtain configurations for use in a restraint in accordance with the invention.

In Figs 1a and 1b a restraint 10 is located adjacent a vehicle side window 12. The restraint 10 comprises a generally triangular inflatable curtain 14 (see Fig 1b) with a braided tube deployment member 16 connected to the curtain 14 along a lower edge thereof. The curtain 14 is hollow with opposite triangular faces sealed around their edges to each other. The term "inflatable curtain" is intended to cover any sheet-like member, at least part of which may be inflated. Thus all of the ar-

the restraints 56, 58 in their deployed states, the restraints 56, 58 overlap to provide a restraint along the whole side of the vehicle 50.

Fig 7 shows a curtain part 14 of a restraint 48 similar to that shown in Fig 3. The curtain part 14 is shown folded out flat.

The curtain part 14 comprises a substantially trapezium shaped central part 60 which is connected at a corner to a pipe 61. Depending downwardly from the long edge of the trapezium shaped central portion 60 is a rectangular flap 62 which can be folded back on itself along a fold line 64 to form a tube for receiving a deployment member 16, 38.

Mounting member receiving flaps 66 extend from the other edges of the trapezium shaped central portion 60. The flaps 66 are arranged to be folded back on themselves to form a tube to receive mounting members (see Fig 8).

Fig 8 shows the curtain part 14 with the flaps 62, 66 shown in their folded positions.

The flaps 66 receive mounting members 68. Each mounting member 68 comprises an elongate metal plate with regularly spaced holes 70 which receive fasteners for fastening the curtain 14 to the vehicle 50. The curtain 14 is shown attached by pipe 61 to a gas generator 24 which is mounted on a gas generator mounting 72. The pipe 61 has a flap 63 therein which divides the pipe 61 into passages 61a, 61b. The passage 61a leads to the interior of the central portion 60. The passage 61b leads to the tube formed by the flap 62 for connection to a braided tube deployment member 16.

The gas generator mounting 72 is shown in more detail in Fig 9. The gas generator mounting 72 comprises a bracket 74 with spaced gas generator receiving loops 76 thereon. The bracket 74 has tabs 78 which are received in slots 80 of a gas generator mounting plate 82. The mounting plate 82 has holes 84 for receiving fasteners which fasten the generator mounting 72 to the vehicle 50. On assembly, the gas generator 24 is received in the pipe 61. The bracket is then pushed over the generator 24 which is surrounded by the pipe 61. The loops 76 secure the generator 24 in place. The pipe 61 has apertures 65 therein and the tabs 78 pass through the pipe apertures 65. The bracket 74 is attached to the mounting plate 82 by inserting the tabs 78 through the respective slots 80 and bending the tabs over to secure the bracket 74 to the plate 82. Once assembled, the loops 76 and the plate 82 secure the pipe 61 around the generator 24 in a gas-tight manner. The plate 82 can then be secured to the vehicle by fasteners extending through the holes 84. The gas generator 24 is arranged in fluid communication with the restraint 48 via the pipe 61. The bracket 74 may be fastened to the plate 82 by other fasteners, such as screws (not shown). The fasteners may secure the bracket 74 to the plate 82 and the assembly to the vehicle 50.

Fig 10 shows the central portion 60 of the curtain 14. The central portion 60 has an internal arrangement

of tubes 86 which are inflated before the remainder of the central portion 60 to provide the curtain 14 with structural rigidity. The arrangement of tubes comprises a tube 88 which extends around the upper periphery of the portion 60 and four tubes 90, 92, 94, 96 depending downwardly therefrom.

The four tubes 90, 92, 94, 96 vent to atmosphere via restrictors which are represented schematically in Fig 10. The tube 88 opens to the interior of the curtain. Also vent holes are provided in the tube 88 and the tube 92 which vent to air bags 98 for the heads of vehicle occupants (see Figs 11a, 11b). The tubes are preferably arranged, on inflation, to bring the air bags 98 into positions suitable for protecting vehicle occupants, for instance, adjacent a door pillar of the vehicle.

Embodiments of head air bags 98 are shown in Figs 11a and 11b. In Fig 11a the air bag 98 comprises an air bag having two vent holes to allow venting from the curtain 14 to the bag 98. In Fig 11b the head air bag 98 has three ears 100 protruding therefrom which have vent holes therein and which help to locate the bag, upon inflation.

Fig 12 is a schematic sectional view of a vehicle 50 showing the location of the restraint 10 in its undeployed state. The vehicle 50 has a ceiling lining 102 and a door pillar 104, defining a recess 106 therebetween. The recess 106 receives the restraint 10 and the restraint is concealed by means of a finisher 108 which is attached to the ceiling liner 102 by means of fastenings 110. The finisher 108 comprises an elongate strip of resilient material 112 which extends across the recess 106 between the ceiling lining 102 and the door pillar 104.

Figs 13a and 13b show schematically a restraint in accordance with a first aspect of the invention in which multiple deployment members are used. In that way, the restraint can be deployed even more quickly and the deployment members 38a, 38b, 38c provide additional structural rigidity to the curtain 14 when inflated.

In Figs 14a and 14b, additional structural members 114 are provided between the multiple deployment members 38a, 38b, 38c to provide improved rigidity. The structural members 114 are ribs or loops of material which are secured at each end to respective deployment members 38a, 38b, 38c.

Figs 15a and 15b show a restraint in accordance with the fourth aspect of the invention. In Fig 15a, the restraint comprises a curtain or other air bag (not shown) with a non-extensible flexible member 116 connected thereto. The non-extensible flexible member 116 prevents the bag or curtain from over-inflating or, where a deployment member is used, from extending beyond the deployment position of the restraint. The non-extensible flexible member 116 has loops 118 which run along guide rails 120 which are inclined at 90° to each other. On inflation of the bag the loops 118 run along the guide rails 120 until the non-extensible flexible member 116 is taut. The tautness of the non-extensible flexible member then prevents the restraint from travelling any fur-

the solenoid is operable by means of a pressure sensor connected to inflating means for inflating the curtain.

12. An inflatable restraint according to claim 10 in which the solenoid is operable on receipt of a signal, said signal also initiating inflating means for inflating the curtain. 5
13. An inflatable restraint according to any preceding claim in which a plurality of deployment members is provided. 10
14. An inflatable restraint according to claim 13 in which the deployment members are connected by structural members so as to provide structural rigidity to the curtain upon deployment thereof.
15. An inflatable restraint according to any preceding claim in which the curtain includes strengthening ribs. 20
16. An inflatable restraint according to any preceding claim in which the curtain includes tubes which are arranged to be inflated before the remainder of the curtain to provide structural strength to the curtain and to aid correct deployment. 25
17. An inflatable restraint according to any preceding claim in which the curtain has an air bag arranged so that when the curtain is deployed the bag is located at the head height of an occupant. 30
18. An inflatable restraint according to claim 17 in which the air bag or curtain has an inflatable member to bring the air bag into an operative position. 35
19. An inflatable restraint according to any preceding claim in which the curtain includes an inflatable guide member for directing the curtain away from an obstruction in a vehicle. 40
20. An inflatable restraint according to any preceding claim in which the curtain deploys downwardly into the occupant protection position. 45
21. A vehicle having therein an inflatable restraint according to any preceding claim.
22. A vehicle according to claim 21 in which the curtain is located along one whole side of the interior of the vehicle. 50
23. A vehicle according to claim 21 in which one curtain is located at the front on one side of the interior of the vehicle and a second curtain is located at the rear on said side of the interior of the vehicle. 55

24. A vehicle according to claim 21, 22, or 23 in which the curtain is located in a slot in a roof rail of the vehicle and/or in a slot in a door pillar or pillars of the vehicle.

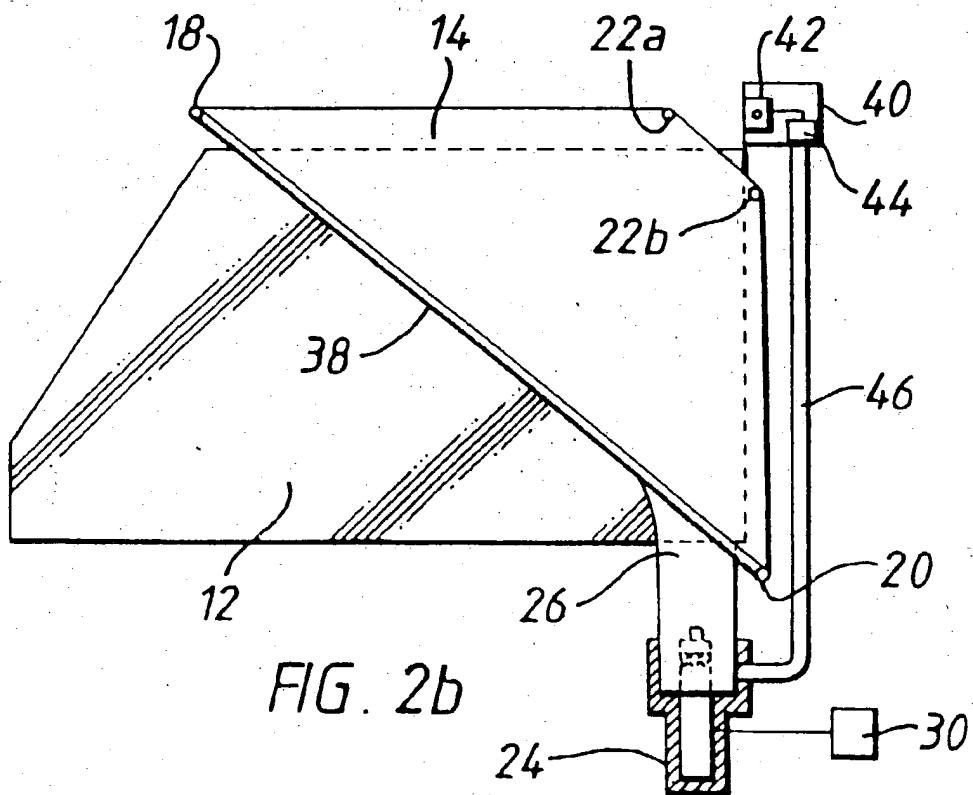
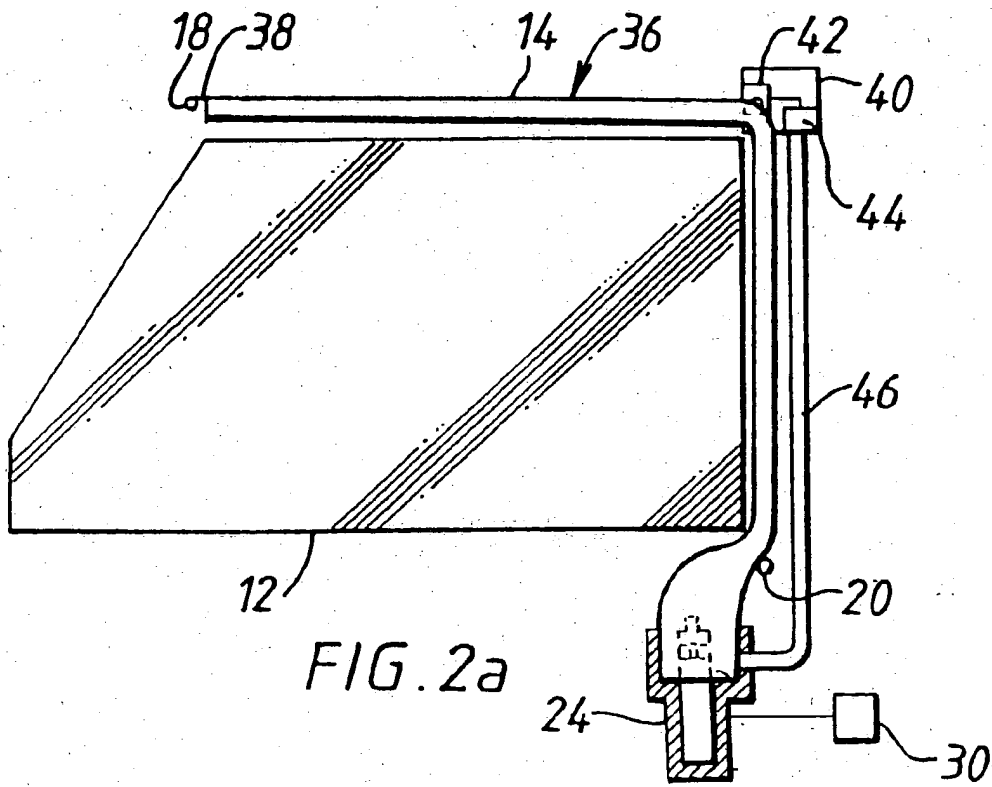
25. A vehicle according to any of claims 21 to 24 in which the deployment member is elongate and is connected at each of its ends to the vehicle.

26. A restraint for a vehicle occupant comprising an inflatable curtain including a formation which guides the curtain away from an obstruction in the vehicle when inflated.

27. A restraint for a vehicle occupant comprising an inflatable bag having a non-extensible flexible member connected thereto whereby expansion of the bag is limited by the flexible member becoming taut on inflation of the bag.

28. A restraint according to claim 27 in which the bag is an inflatable curtain and the flexible member is connected to the curtain along a leading edge thereof.

29. A method of deploying an inflatable restraint for a vehicle occupant comprising the steps of: providing an inflatable curtain providing an elongate deployment member connected to the curtain and contracting the deployment member longitudinally in order to move the curtain into an occupant protection position.



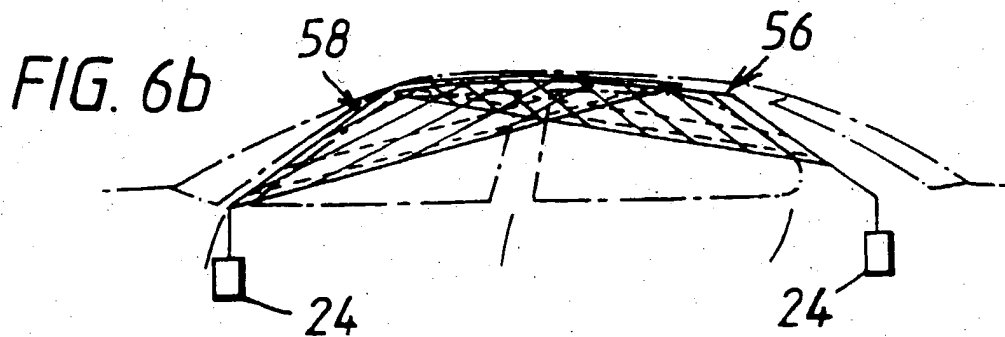
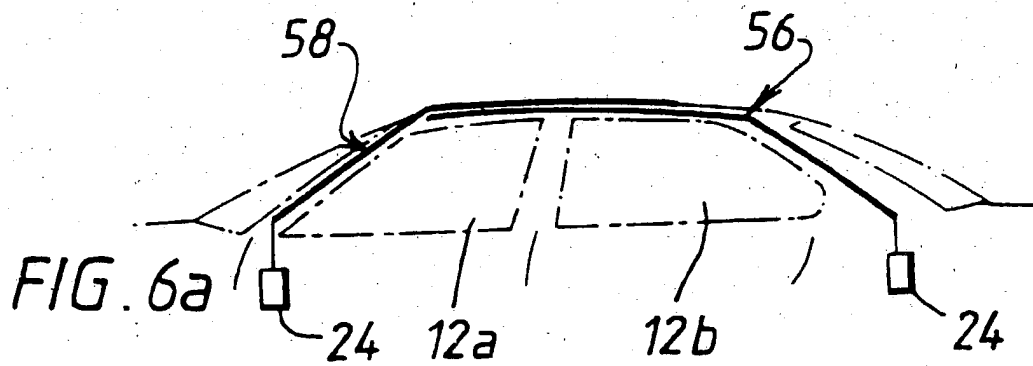
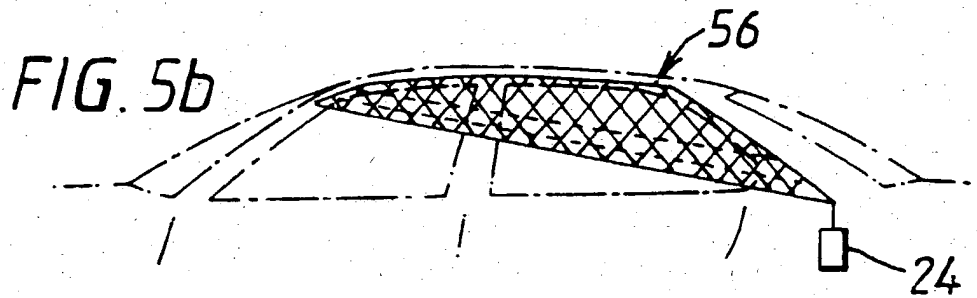
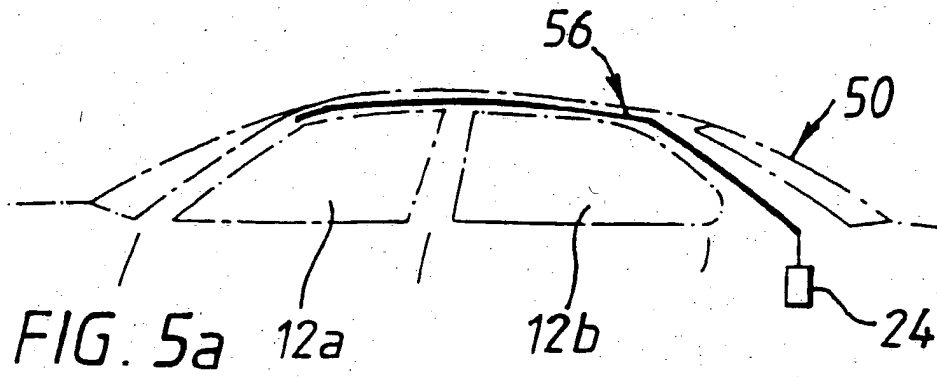


FIG. 9

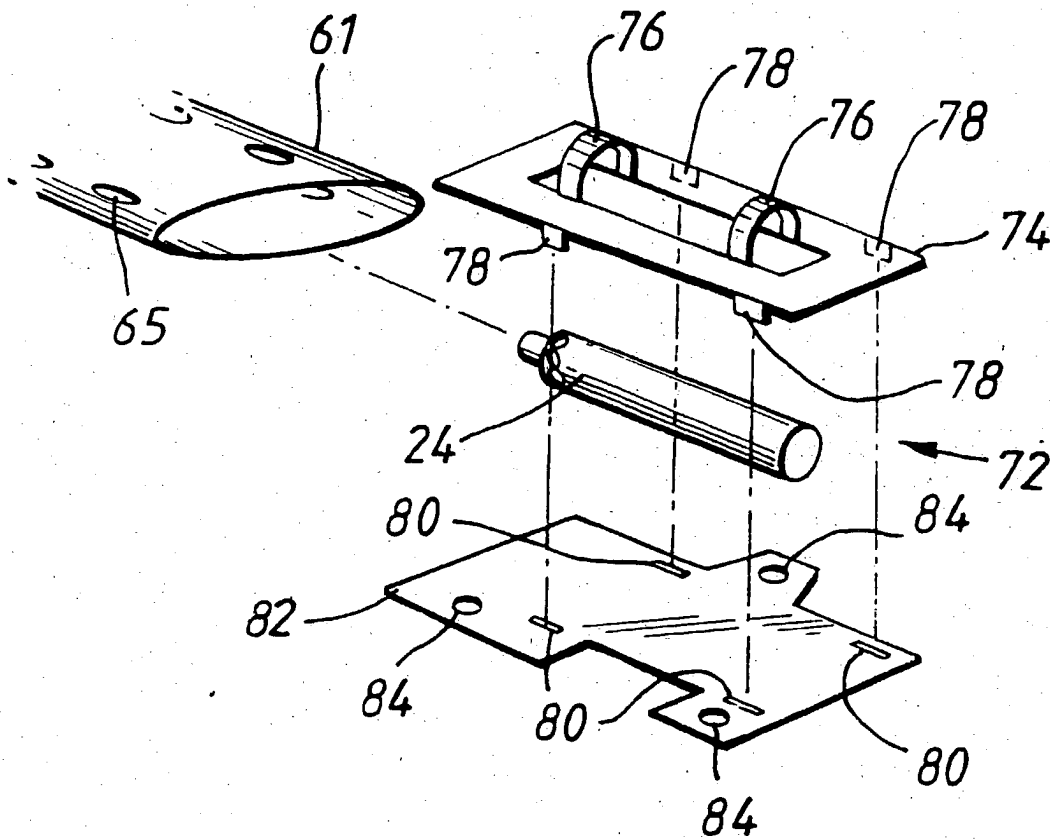


FIG. 10

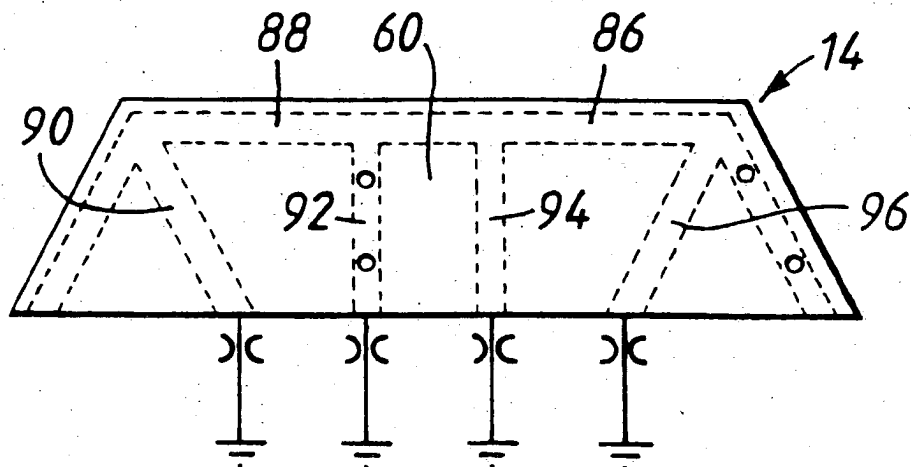


FIG. 13a

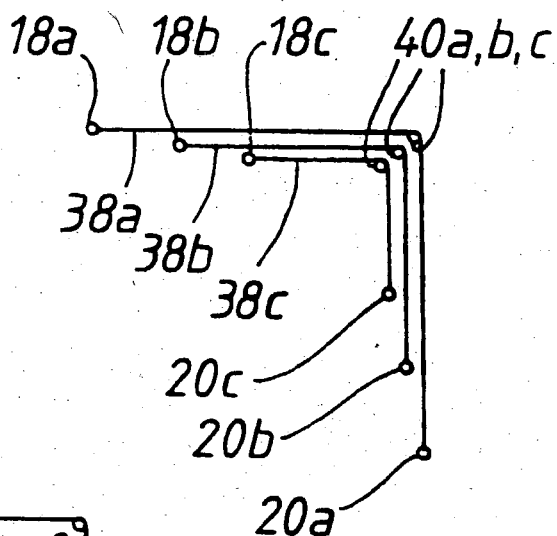


FIG. 13b

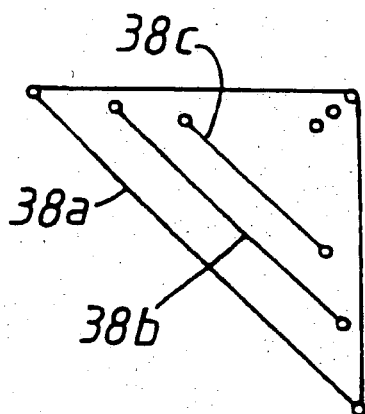


FIG. 14a

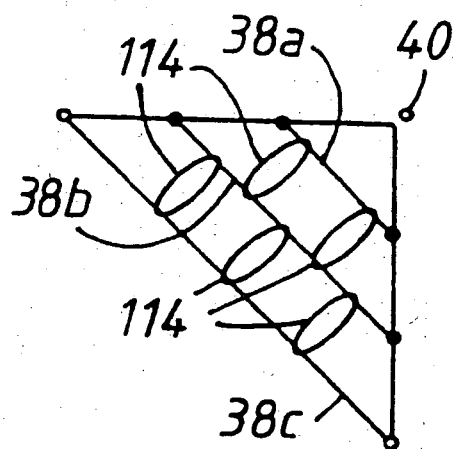
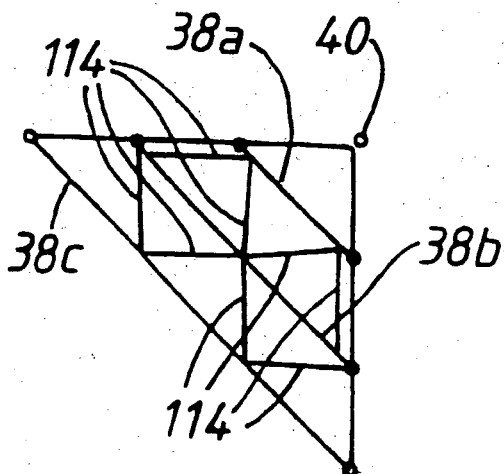
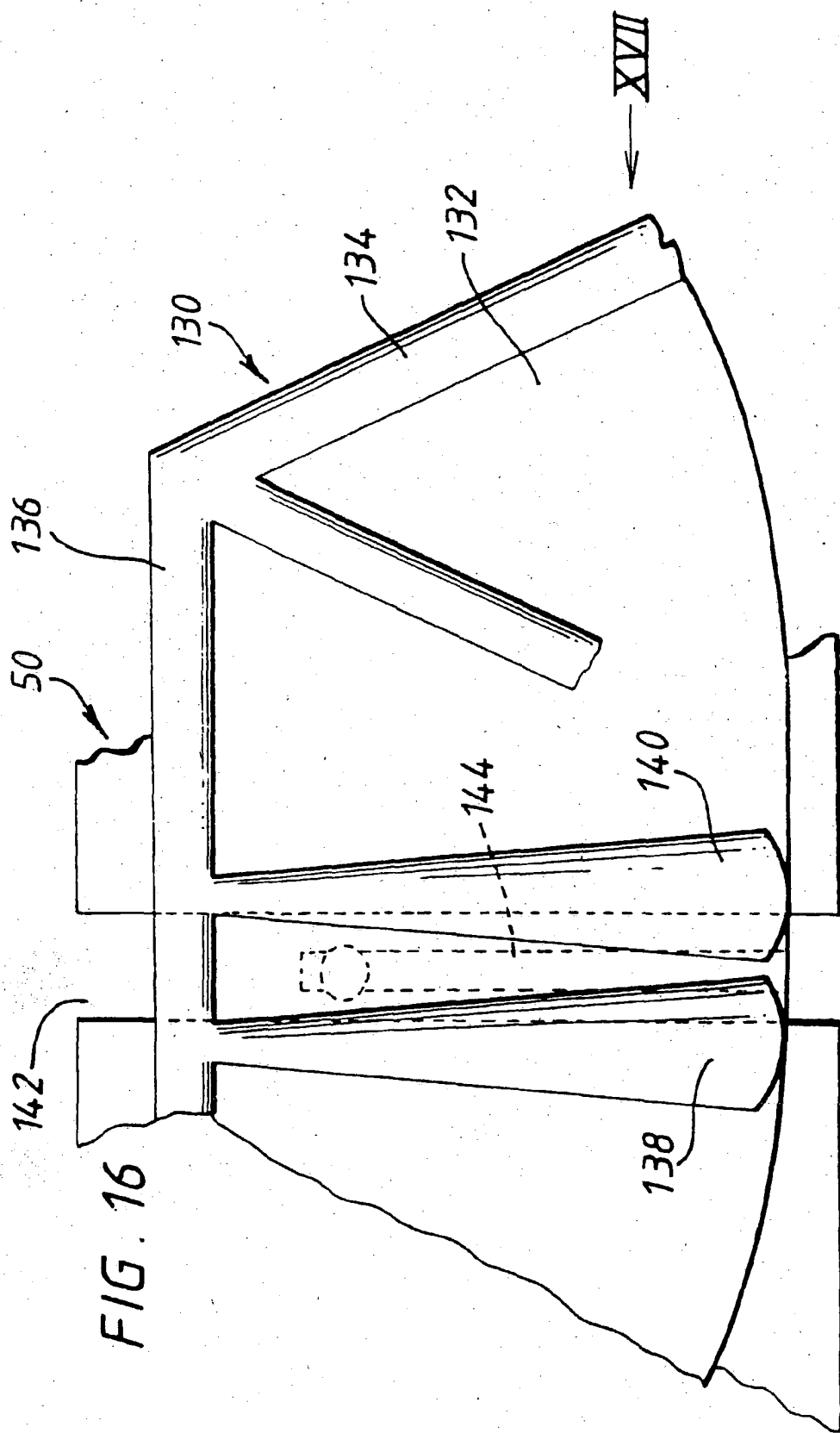


FIG. 14b







European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 7256

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE 43 37 656 A (AUDI NSU AUTO UNION AG)	1-3, 17, 20-22, 24	B60R21/22
A	* figures 1-3 * * column 5, line 11 - line 57 * * claims 1, 17, 18 *	4-6, 8, 18, 23, 25, 27-29	
X	GB 2 261 636 A (TAKATA CORP)	1-3, 21, 24, 25, 27, 28	
A	* figures 15-20 * * abstract * * page 13, line 12 - page 15, line 10 *	4-6, 8, 17, 19, 20, 22, 29	
X	EP 0 590 518 A (TRW REPA GMBH)	1, 2, 6, 15, 20, 21, 24	B60R
A	* figures 1, 4 * * abstract * * column 2, line 28 - line 42 *	3, 5, 7, 8, 16-18, 22, 23, 25, 27-29	
X	WO 93 09977 A (KOLBENSCHMIDT AG ; DYNAMIT NOBEL AG (DE); SIEMENS AG (DE))	1, 2, 8, 21, 24	
A	* figures 3, 4 * * abstract * * page 6, line 1 - page 7, line 16 *	3, 5, 6, 9, 15-17, 20, 22, 23, 25, 27-29	
-/--			
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		16 December 1997	D'sylva, C
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			